



**Wisconsin Highway Research Program
Request for Proposal for**

Permeability Performance and Lateral Load for Granular Backfill behind Abutments

**Questions regarding the content of this RFP are due no later than
4:30 PM (CST), Monday, December 10, 2012**

**Responses to questions will be posted to the WisDOT Research and Library website
(<http://wisdotresearch.wi.gov/rfps-and-proposals>) by
4:30 PM (CST), Monday, December 17, 2012**

**Proposers must submit an electronic version of a proposal (Adobe PDF required) by
4:30 PM (CST), Friday, January 25, 2013
to apakes@sustainability.wisc.edu**

**For further information regarding this RFP contact:
Angela Pakes Ahlman
email: apakes@sustainability.wisc.edu**

Researcher Questions on RFP

Please refer all questions on this RFP to the WHRP Technical Director, Angela Pakes Ahlman by the aforementioned due date. Questions must be in writing. No response will be provided to questions received after the due date.

Researcher Proposal Preparation Guidelines

WHRP Proposal Guidelines are available on the WisDOT Research and Library website (<http://wisdotresearch.wi.gov/wp-content/uploads/WHRP-RFP-Guidelines-11-26-12.pdf>). Please refer to these instructions in preparation of your response.



**Wisconsin Highway Research Program
Request for Proposals
Geotechnical Technical Oversight Committee**

Title

Permeability Performance and Lateral Load for Granular Backfill behind Abutments

I. Background and Problem Statement

The purpose of the granular backfill behind bridge abutments is to provide a frictional material that drains, which allows the abutment to be designed with relatively low lateral forces. Under ideal conditions, these forces can be separated into the following items:

- Low lateral earth pressure (as controlled by stress state, angle of internal friction, and total unit weight)
- Elimination of lateral water pressure

These assumptions allow the design of the abutment to use less reinforcement and apply a lower design lateral force on the abutment piles.

The current design uses a qualitative approach that assumes there is no lateral water pressure on the abutment. The assumption is that the granular backfill is “free-draining” based on the specified grain size distribution; thus, any water that infiltrates into the granular backfill will rapidly drain out of the system. However, that assumption does not consider rate of water infiltration, the permeability of the granular backfill, the water retention characteristics of the backfill, the effects of water retention on lateral earth pressure distribution, and the short- and long-term effectiveness of the pipe underdrain.

In addition, alternative materials have been proposed to replace the specified granular backfill. These materials include Recycled Asphalt Pavement (RAP) and foundry sand. The permeability, water retention, and mechanical characteristics of these materials that control lateral loads on abutments are not sufficiently characterized.

II. SCOPE

This research project can be divided into five phases. The first phase will be to conduct a thorough literature search to document any similar studies that may have been completed. This search will also include gathering other background data/studies that would have applicability to this research (including other state DOT’s practices).

The second phase of the work will be to develop and implement a work plan for determining the drainage and lateral load characteristics of granular fill behind abutments. The work plan should include a field monitoring program at representative test location(s) for structural backfill and granular grade 1 materials, and may also be supported by concurrent laboratory characterization and numerical modeling efforts. A minimum of four test locations will be evaluated examining both structural backfill and granular grade 1 materials.



The work plan should provide quantitative analyses to account for rate of water infiltration, a method to determine the water flow lines and pore pressure distribution in granular fill, performance of the pipe underdrain, the total unit weight of the granular material, the friction angle of the granular material, and corresponding implications to lateral load on the abutment.

The third phase will involve evaluation of results from the work plan to provide guidance for design values used to determine the lateral load from granular fill on abutments. Guidance and recommendations should account for the permeability and water retention characteristics of the backfill.

The fourth phase will examine alternative materials including Recycled Asphalt Pavement (RAP) and foundry sand to determine the feasibility of using these materials as a replacement for granular backfill behind abutments.

The fifth phase of work will require presenting all the data, findings, analyses and recommendations in a final report and presentation to the Technical Oversight Committee.

III. SPECIFIC RESULTS, FINDINGS, TOOLS, ETC.

Findings from the research should include the following:

- Results of the field evaluations to monitor pore pressure within the granular backfill and performance of the base drain and the lateral forces on the back of the abutment.
- Results of analysis that evaluates the permeability, water retention, and lateral forces behind an abutment based upon the field evaluations.
- Evaluation of alternative materials as a replacement to granular backfill behind abutments.
- Recommendations with respect to the current state of practice of WisDOT's granular fill behind abutments (design parameters) and the impact of using alternative materials.

A final report documenting all research findings and conclusions will be required. Implementation of findings will be conducted by WisDOT, as appropriate.

IV. LENGTH OF RESEARCH PROJECT AND APPROXIMATE COST

It is estimated that the time required for the five phases of the project should not exceed 24 months. The draft final report should be submitted in electronic format after month 15 to accommodate TOC review, scheduling of the final presentation and incorporation of review comments in the final report. The researcher will deliver eight paper copies of the final report, along with an electronic version. The cost is estimated to be \$150,000. As part of the researcher selection criteria, the TOCs will evaluate the time and cost estimates in the submitted research proposals.

V. URGENCY AND POTENTIAL BENEFITS

WisDOT transportation facilities use granular backfill behind abutments to reduce the lateral forces on the abutment. The study would provide an assessment of the performance of the



granular backfill at meeting the “freely-draining” assumption and evaluate the potential use of alternative materials.

VI. ADDITIONAL REQUIREMENTS FOR IMPLEMENTATION

Results from this study will provide the WisDOT with information for evaluating the current status and performance of granular backfill behind abutments. The project will provide recommendations for the performance of the granular backfill behind abutments and the potential use of alternative materials, but the actual incorporation of results will be the responsibility of the WisDOT.